UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF PREVENTION,
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

TO: Ben Chambliss, CRM
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FROM: David Farrar, Statistician, EFED task leader for Phorate
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THROUGH: Betsy Grim, Acting Branch Chief
EFED/ERB II

DATE: August 30, 1999

RE: **Phorate**:
Completion of response to comments from American Cyanamid Co.;
Revision of exposure estimates for surface and ground water;
Updated EFED RED chapter;

DP BARCODE: D251987

On Dec. 23, 1998 EFED responded to comments from American Cyanamid Co. (Oct. 12, 1998) related to a draft EFED RED chapter, and provided a RED chapter that was updated to address a portion of Cyanamid's comments. EFED's 12/98 memo indicated that some items were still under review. The purpose of this communication is to provide a RED chapter updated to address comments from Cyanamid that were under review. (A revised RED chapter is attached.)

EFED's description of the phorate terrestrial incidents has been revised, without changing the bottom-line conclusion that the incidents provide a strong basis for concern (see particularly the Risk Characterization section).

Incorporation of new fate information submitted by American Cyanamid Co.

Cyanamid has submitted guideline studies of fate properties of phorate sulfone and phorate sulfoxide, and a detailed review (G. Mangel, 9/14/98) based to some degree on journal articles. EFED has reviewed the journal articles, guideline studies, and a formation and decline spreadsheet document developed by G. Mangel. Based on this information, EFED has independently developed an analysis of formation and decline. Formation and decline constants from some of the studies were used in PRZM-EXAMS modeling, while other studies were referenced but not used quantitatively.

In addition, Cyanamid has submitted new guideline studies of mobility in soil for phorate metabolites, and hydrolysis and aerobic aquatic metabolism studies for parent phorate and phorate metabolites. This information has been incorporated into the RED chapter.

Revision of Exposure Estimates for Surface and Ground Water.

For both surface water and ground water, EFED has calculated exposure estimates in two ways: (1) for parent phorate only; and (2) for total toxic residue (parent phorate + phorate sulfoxide + phorate sulfone). For ground water, only the results for total toxic residue are presented in the RED chapter. (It appears that any phorate residues that reach ground water will be primarily phorate metabolites rather than parent phorate.) The revised estimates make use of all available fate information including material recently submitted by American Cyanamid. For surface water, we have used current model versions, which are PRZM 3.12 and EXAMS 2.975.

EFED has assumed a single application per year for each crop and procedure simulated. The labels actually permit two applications per year for corn (field and sweet) and grain sorghum. EFED is at this time conducting simulations assuming two applications per year for these crops.

For surface water, EFED has recalculated concentrations for phorate applied to field and sweet corn, peanuts, cotton, potatoes, and grain sorghum. The simulated application techniques included t-banded, in-furrow at planting and side-dress application once the applicable crop had emerged. These crops represented the maximum application rates and primary crops to which phorate is applied, and give the maximum EECs for applied phorate.

EFED did not simulate applications to sugarcane because the label states that this use is restricted to Florida. Florida sugarcane is grown primarily around Lake Okechobee, where water levels in the fields are managed by flooding canals. Therefore, it is impossible to properly simulate this scenario because of fluctuating water levels. In previous RED Chapters, EFED simulated application to sugarcane in Louisiana, but is no longer using this scenario for phorate in sugarcane.

EFED also did not simulate applications to winter wheat (North Dakota), soybeans (Iowa), dried beans (Michigan), or potatoes in Maine in the current RED Chapter. In previous modeling, winter wheat has been found to have low EECs as compared to other crops. Soybeans and dried beans are relatively minor uses compared to other crops, and phorate is not used significantly in Maine for potatoes. Also, EFED is now using an Ohio field corn scenario instead of the Iowa field corn scenario used in previous RED Chapters.

Responses to technical comments from Cyanamid on the environmental fate of phorate.

(See also EFED's response below to the Gagne-Mautz memo.)

• Cyanamid argues that important degradation pathways go directly to nontoxic metabolites rather than through p. sulfone and p. sulfoxide.

Response: Cyanamid is correct in noting that parent phorate degrades to both non-toxic and toxic metabolites in soil and water. EFED incorporated this information in the August 1999 Revised RED Chapter. EFED also incorporated this information into the surface water modeling, where the formation and decline constants for each metabolite were mathematically factored in the PRZM-EXAMS modeling.

• Regarding absorption-desorption kinetics of Phorate metabolites, in relation to runoff potential, Cyanamid argues that incorporation and leaching will tend to move the metabolites to a depth of 2-6 inches, so that runoff would be minimal. These conclusions are based on studies and other submissions under a separate cover dated 9/14/98.

Response: The registrant is generally correct in saying that movement of phorate and metabolites (or any pesticide) to 2-6 inches of depth will reduce surface runoff. Surface runoff is likely to decrease with increasing depth of placement in the soil. However, the registrant does not consider capillary action, where the soil water moves toward the surface of the soil in response to surface drying in finer-textured soils. This vertical movement of water may carry pesticides from lower soil depths to the surface, where it may be available for runoff. However, with deeper placement in the soil, the risk for ground water contamination becomes greater.

• Based on information in the Mangel review, Cyanamid argues that Phorate metabolites will degrade rapidly enough that they have low potential to contaminate ground water and will pose low chronic concern.

Response: For phorate sulfoxide, the half-lives calculated from the different guideline and literature studies ranged from 17-100 days in the soil. For phorate sulfone, the half-lives calculated from the different guideline and literature studies ranged from 15-30 days to >500 days, depending on the data available and the method of calculation. However, some of the studies were not carried out for long enough to establish the decline of phorate sulfone.

EFED cannot confidently state a half-life long enough that ground water contamination will tend to occur. Nor can EFED say with much confidence that half-lives below a specific number of days will *not* lead to ground water contamination. In general, the risk of ground water contamination will increase with increasing persistence and mobility, and will depend on the treated soils, the depth to ground water, and the general climate.

Regarding possible chronic effects of metabolites, EFED has calculated chronic risk quotients for aquatic organisms based on the estimated combined concentration of parent phorate, phorate sulfone, and phorate sulfoxide. Based on an assumption of equal toxicity of parent phorate and phorate degradates, EFED used toxicity values for parent phorate in these calculations. Inclusion of phorate degradates resulted in a several-fold increase in the values of risk quotients.

• Cyanamid disagrees with the mobility constants (K_{ads} values) that were presented and used in the RED and with EFED's interpretation of the mobility constants. Cyanamid cites a soil mobility study conducted by Cyanamid (MRID 40174525) containing lower estimates of leaching potential than a study conducted by another registrant (MRID 42208201).

Response: Cyanamid is correct in noting that the results from the laboratory studies can be taken as indicators of potential mobility and persistence. They also cite another soil leaching-adsorption-desorption study in which they claim total phorate residues are less mobile than in the study cited by EFED. However, it appears that the data they are citing are in the same range as the values EFED uses (K_{ads} of 5-10 versus K_{ads} of 1.8-12).

• Cyanamid disagrees with the value for anaerobic soil metabolism that was used by EFED: EFED used a value of 32 days; Cyanamid cites a value of 13.6 days.

Response: The registrant refers to Figure 3 of the anaerobic soil metabolism study and suggests that the half-lives of parent phorate and phorate sulfoxide are 13.6 and 6.9 days, respectively. Since the previous version of the RED Chapter, EFED has recalculated the half-life of 32 days. The data from the anaerobic phase of the study show a linear half-life of 26.5 days, instead of the 13.6 days cited by the registrant. Also, for phorate sulfoxide, it is not possible to calculate a half-life because the concentration appeared to increase with anaerobic incubation time. The data that support a 6.9 day half-life for phorate sulfoxide is not evident. Therefore, EFED contends that the half-life for parent phorate in anaerobic soil is 26.5 days, and that no half-life can be calculated for phorate sulfoxide.

• Cyanamid comments on EFED’s Tier II EEC estimates. Cyanamid argues that PRZM3 can represent various incorporation practices more accurately and disagrees with various inputs used by EFED.

Response: Cyanamid argues that the PRZM 2.3 modeling contained errors in inputs, overestimated concentrations due to overconservative extraction routines, and did not accurately incorporate the compound (assumed uniform distributions instead of proper placements). EFED reran the modeling using PRZM 3.12, which uses the new incorporation and pesticide extraction features. EFED also recalculated the half-lives and incorporated additional information on the degradation of phorate and the formation and decline of phorate sulfoxide and sulfone in the field and in the pond. EFED then provided concentrations in the pond for parent phorate only and for parent phorate plus the sulfoxide and sulfone metabolites. The results of the modeling did not change our conclusions for parent phorate, and increased both the acute and chronic values because it took into account the metabolites.

EFED response to the Dec. 3 1990 memo, Gagne to Mautz.

In recent communications, Cyanamid has repeatedly cited a Dec. 3 1990 memo from J. Gagne to M. Mautz, particularly in connection with interpretation of the terrestrial incident B000150-015 (March 1989, Hughes County S. Dakota). The incident is associated with application to winter wheat in September of the year preceding the incident. The current EFED RED chapter treats the incident as probably due to phorate use and not attributable to misuse. In a review of EFED files we find no previous review of the Gagne-Mautz memo. In order to respond fully to Cyanamid's comments, the EFED team obtained and reviewed a copy of the Gagne Mautz memo.

The memo contains summaries of two studies, a study by the Fish and Wildlife Service (FWS), of phorate residues in tissues and environmental media from the incident location, and a study undertaken at South Dakota State University (SDSU), of dissipation of phorate residues in soil samples from the location of the incident. We find that some material from the FWS memo was incorporated in versions of the EFED RED chapter that EFED transmitted in December 1998. The discussion of the FWS study has been expanded somewhat in the revised RED chapter attached (see Section C.4.a(4)). For the SDSU study, the dissipation rate of parent phorate was similar to what has been observed previously in aerobic soil metabolisms studies, but the dissipation rate of the metabolites was significantly more rapid. Therefore, in order to use this information, EFED would need to review a complete description of the study.

The study at SDSU evaluated dissipation of parent phorate, phorate sulfone, and phorate sulfoxide in soil samples from 3 locations associated with the incident, at constant temperature (about 21°C or 70°F) and constant soil moisture (70% of field capacity by weight). EFED has suggested that the degradation of phorate might have been unusually slow under the conditions in the fall-winter following the incident. Cyanamid uses the results of the study to argue that degradation would not have been unusual. However, the study at SDSU does not appear to provide specific information related to the incident because environmental conditions in the study might poorly represent environmental conditions in the fall and winter preceding the incident. In particular, we are concerned with the possibility that there were lower temperatures and anaerobic conditions preceding the incident, relative to the conditions in the lab study. We expect some tendency for degradation to be slower under conditions of low temperature and low oxygen.

The FWS study reported that some samples contained phorate metabolites without detectable parent phorate. However, an exception was the gastrointestinal (GI) tract contents of one eagle, which reportedly had parent phorate at 0.7 ppm but concentrations <0.1 ppm for each metabolite. In addition a goose GI tract found within the eagle GI tract had parent phorate at 127 ppm, phorate sulfoxide at 12 ppm, and phorate sulfone at 0.11 ppm.

Cyanamid concludes that the goose was probably killed by ingesting undegraded phorate, and the eagle was killed as a result of eating the goose. Cyanamid suggests that the phorate that killed these two birds was not derived from the September application, arguing that enough time had elapsed since the September application date for parent phorate to have degraded completely to phorate sulfoxide and/or phorate sulfone. Cyanamid supports this conclusion using results of the study at SDSU.

We conclude that the results of the FWS study do not refute EFED's overall conclusion for the incident because they apply to only two of 100 birds killed in the incident. It is our understanding that results for tissues of other bird carcasses associated with the incident are consistent with the conclusion that an incident resulted from use according to labels. In addition, we suggest that there is still uncertainty regarding the dissipation of phorate parent and metabolites under the conditions of the incident, despite the results from the study at SDSU. Also, phorate sulfoxide and phorate sulfone contain an organophosphate functional group and may be toxic. Before reaching any definitive conclusion based on the FWS study, EFED would need to review all of the residue information available for the incident.

The Gagne-Mautz memo also reports that a piece of a THIMET bag was found about 150 yards from the pool where most of the carcasses were found, indicating some improper disposal of bags in the area. However, this does not establish that the incident was due to improper disposal.